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Trace and REE patterns of apatite from a diorite porphyry in hydrothermal alteration zones of the Sharlo Dere area, Chelopech Cu-Au deposit, Bulgaria

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The epithermal high-sulphidation Chelopech deposit is one of the largest Cu-Au deposits in Europe. It is situated in the Central Srednogorie zone, Bulgaria and is related to the magmatic-hydrothermal system of a multiphase Late Cretaceous intrusive to volcano-sedimentary complex.

Extensive drill hole data make Chelopech an excellent site to study ore-deposition processes and the behavior of accessory minerals as geochemical indicators. An important accessory mineral with regards to magmatic and hydrothermal processes in such systems is apatite. Here, we provide new LA-ICP-MS apatite trace and REE data from the Sharlo Dere exploration area of the Chelopech deposit. Progressive hydrothermal alteration zones within a diorite porphyry were investigated, but apatite was found only in the hematitic, propylitic and quartz-sericitic zones.

Apatites from these three alteration zones show similar variations in chondrite-normalized REE patterns with a weak negative Eu anomaly, LREE-enrichment and HREE depletion. They plot in the ore deposit field of the discriminant diagrams DP1-1 vs. DP1-2 of Zhang et al. [1]. Apatite-Eu anomalies versus apatite-Ce anomalies plots show moderate oxidized to oxidized conditions. The Ce and Eu anomalies are higher in the quartz-sericitic zone. Biplots of Sr vs Y and $(La/Sm)_N$ vs $(Ce/Yb)_N$ show that Sr content, $(La/Sm)_N$ and $(Ce/Yb)_N$ decrease with increasing hydrothermal alteration intensity. Apatite trace element mapping reveals an external reaction rims with higher Y content in the quartz-sericitic alteration zone, which are also visible on optical CL images.

Our results indicate that the studied apatites are primary magmatic and characteristic for fertile magma. Their trace element features are not significantly modified in the propylitic alteration zone but in the quartz-sericite alteration zone most indicative elements and ratios trend to values that are characteristic for hydrothermal apatites. Additional work on the mineral chemistry of the apatite and associated minerals is in progress to better constrain the magmatic-hydrothermal processes and to employ the approach as a geochemical indicator.

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[1] Zhang et al. (2024) Minerals. 2024; **14(4)**:373.